US009122230B2

(12) **United States Patent**
Kamigaito et al.

(10) **Patent No.: US 9,122,230 B2**
(45) **Date of Patent: Sep. 1, 2015**

(54) **GROUNDING STRUCTURE**

(71) Applicant: **FUJI XEROX CO., LTD.**, Tokyo (JP)

(72) Inventors: **Naoya Kamigaito**, Kanagawa (JP); **Yasuhiro Kurokawa**, Kanagawa (JP)

(73) Assignee: **FUJI XEROX CO., LTD.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 20 days.

(21) Appl. No.: **14/182,712**

(22) Filed: **Feb. 18, 2014**

(65) **Prior Publication Data**

US 2015/0016008 A1 Jan. 15, 2015

(30) **Foreign Application Priority Data**

Jul. 12, 2013 (JP) 2013-146197

(51) **Int. Cl.**
H05F 3/00 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC .. ***G03G 21/1652*** (2013.01); *G03G 2215/00721* (2013.01)

(58) **Field of Classification Search**
CPC H05F 3/04
USPC 361/214
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,781,757	A *	12/1973	Barnes	439/95
5,826,153	A *	10/1998	Hazama et al.	399/353
7,686,626	B2 *	3/2010	Wu et al.	439/95
8,359,607	B2 *	1/2013	Yamauchi et al.	720/650

FOREIGN PATENT DOCUMENTS

JP	A-09-309245	12/1997
JP	A-2000-010457	1/2000

* cited by examiner

Primary Examiner — Stephen W Jackson
(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

Provided is a grounding structure including a grounding member that is grounded, an electrical conduction member that includes a protection section which is placed to protect a protection object, and an elastic portion which is connected to the protection section and is elastically deformed, the electrical conduction member being conductible, and a holding section that is formed in the grounding member and that holds the elastic portion in the grounding member by using an elastic force of the elastic portion, wherein the holding section and the elastic portion contact with each other on both sides of a direction in which the elastic force of the elastic portion acts.

5 Claims, 7 Drawing Sheets

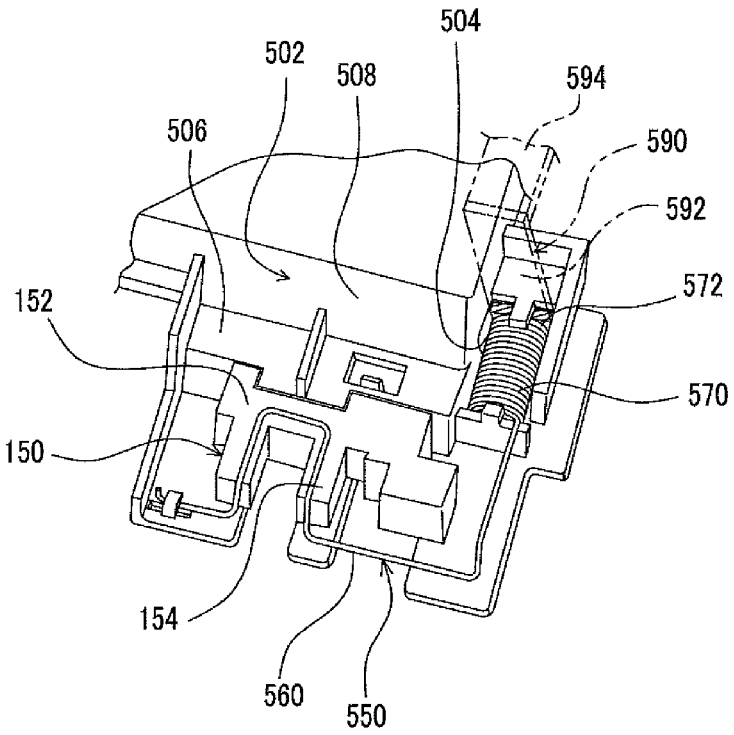


FIG. 1

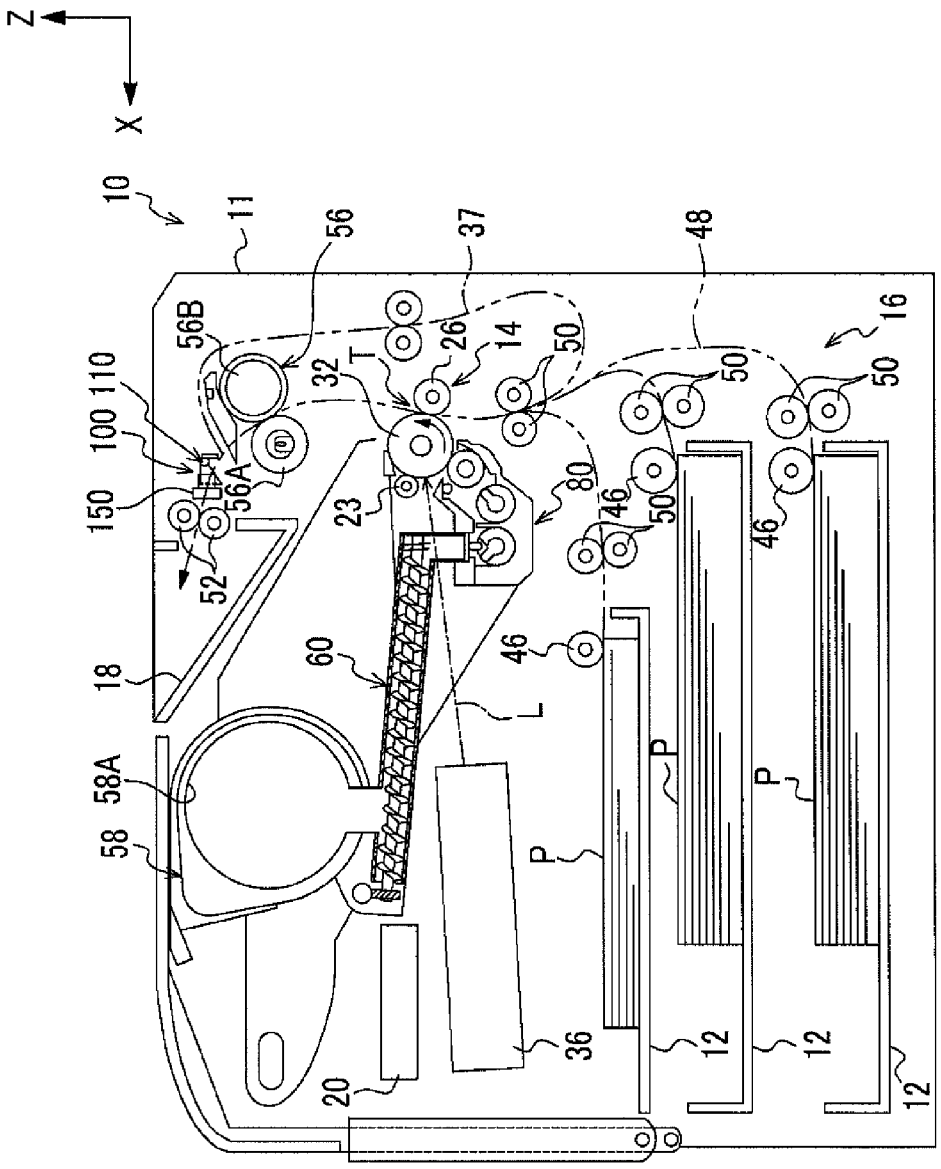

Z
X
10
11
56
37
48
16
56B
26
14
50
32
T
110
100
150
56A
23
80
46
52
60
18
L
58A
58
P
36
12
20

FIG. 2

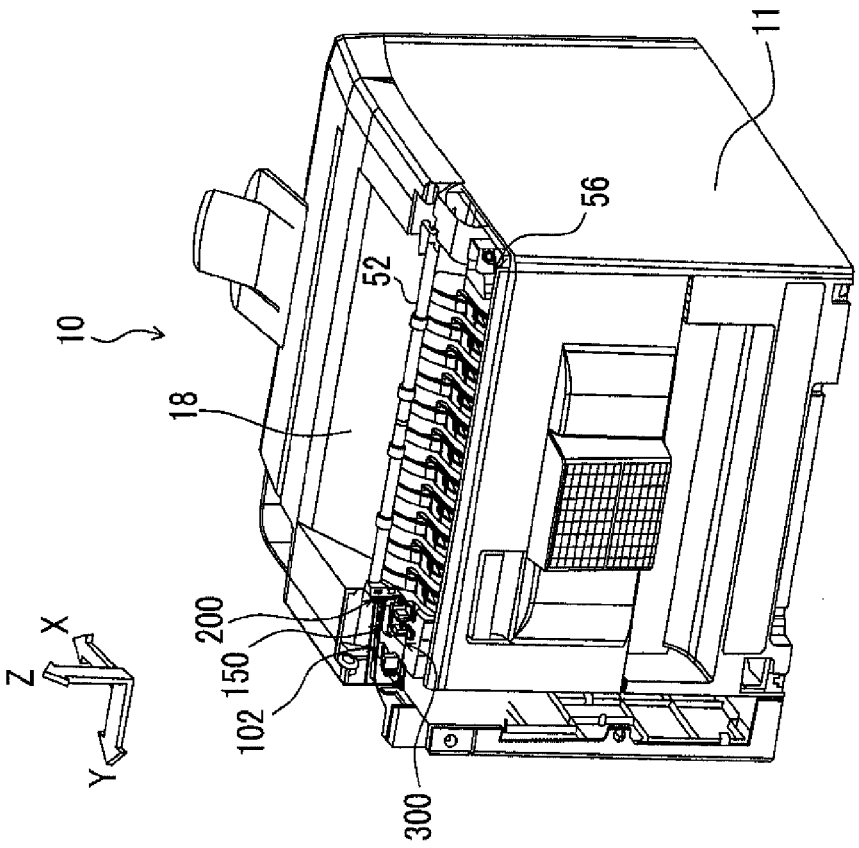


FIG. 3

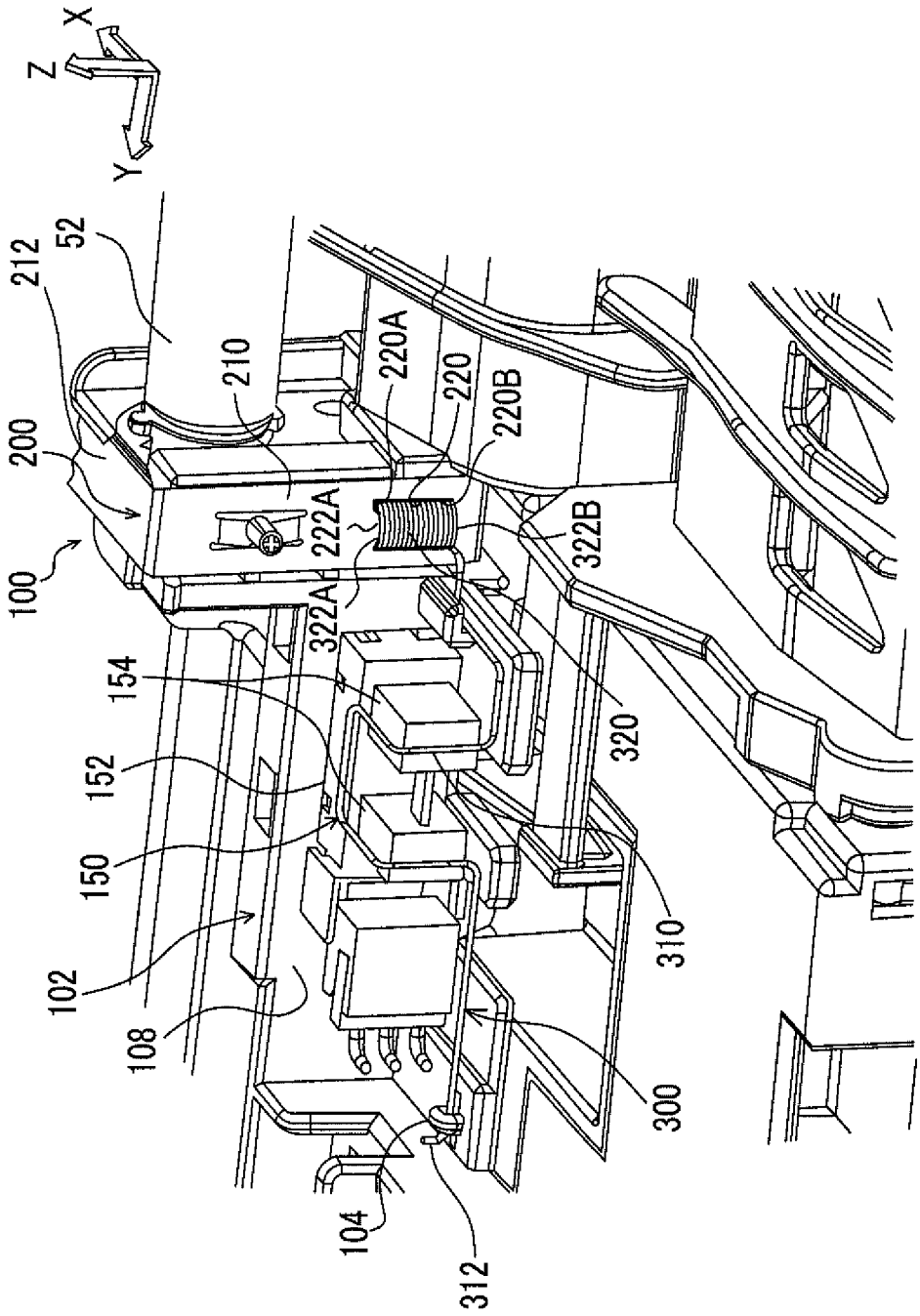

X
Z
Y
212
52
210
220A
220
220B
200
222A
322B
100
322A
154
320
152
150
310
102
108
300
104
312

FIG. 4A

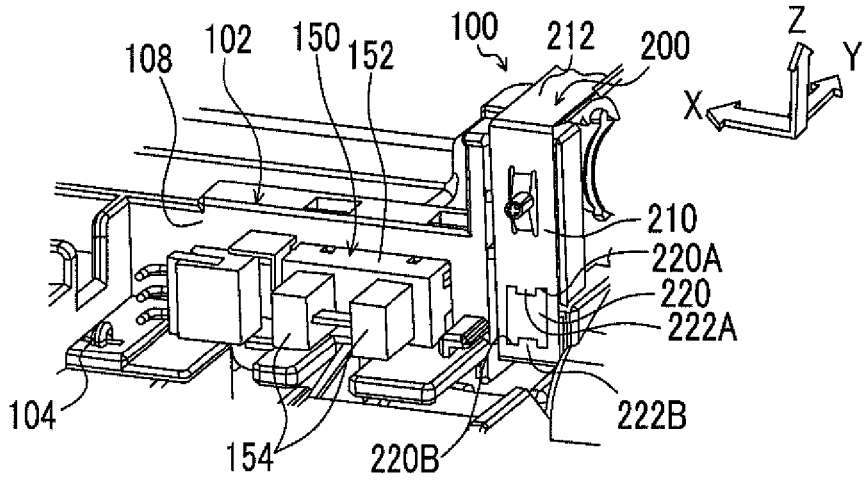


FIG. 4B

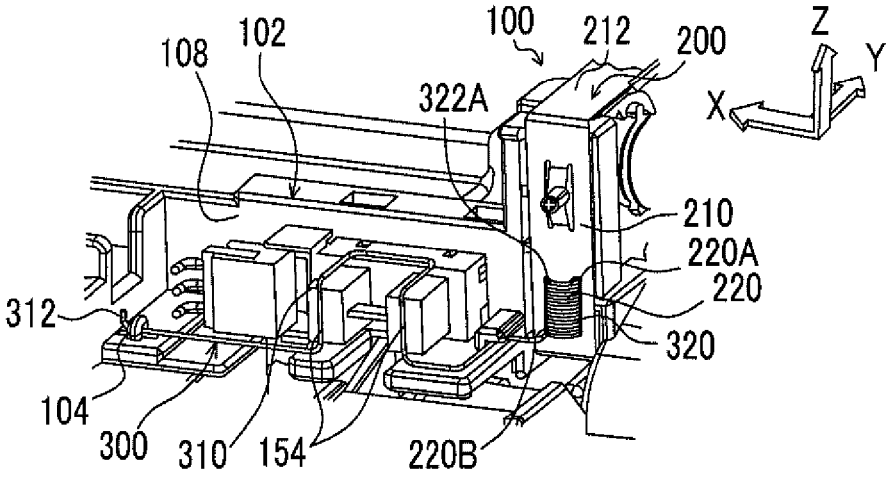


FIG. 4C

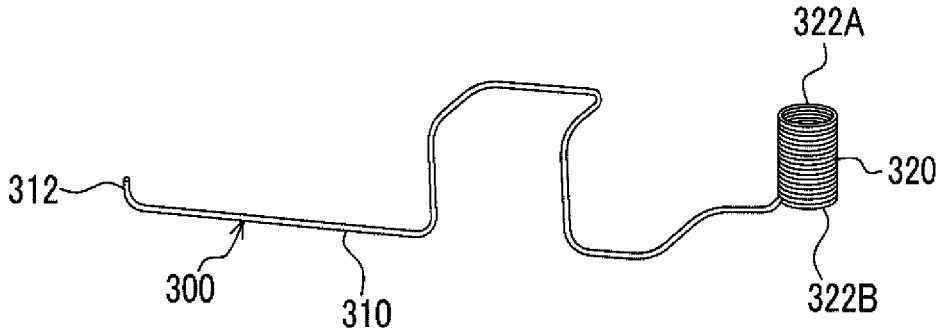


FIG. 5A

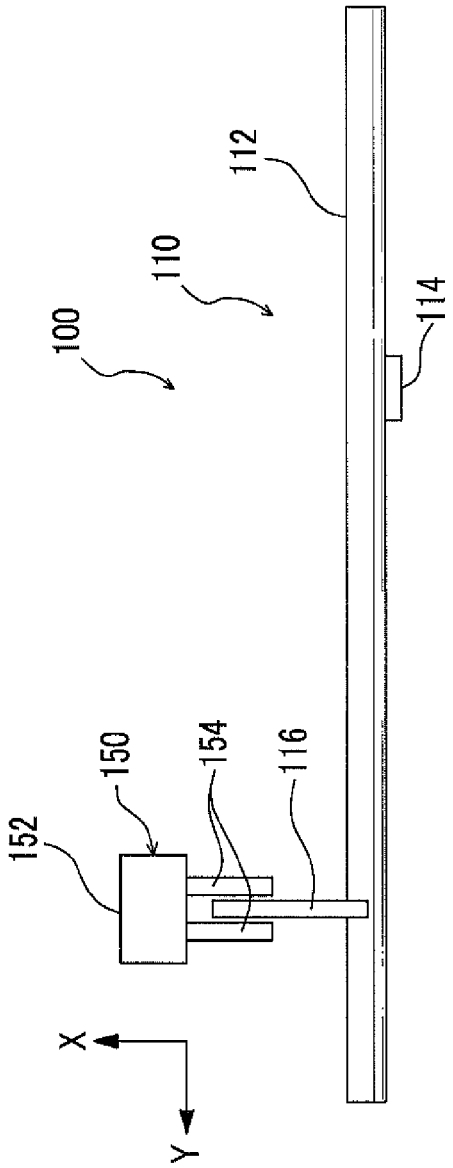

112
110
100
114
150
154
116
152
X
Y

FIG. 5B

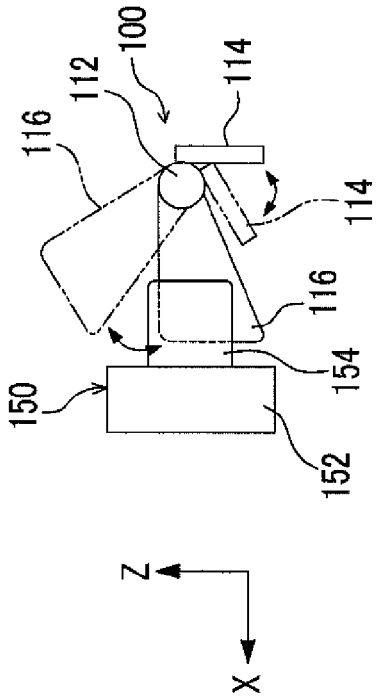

116
112
100
114
114
116
154
150
152
Z
X

FIG. 6

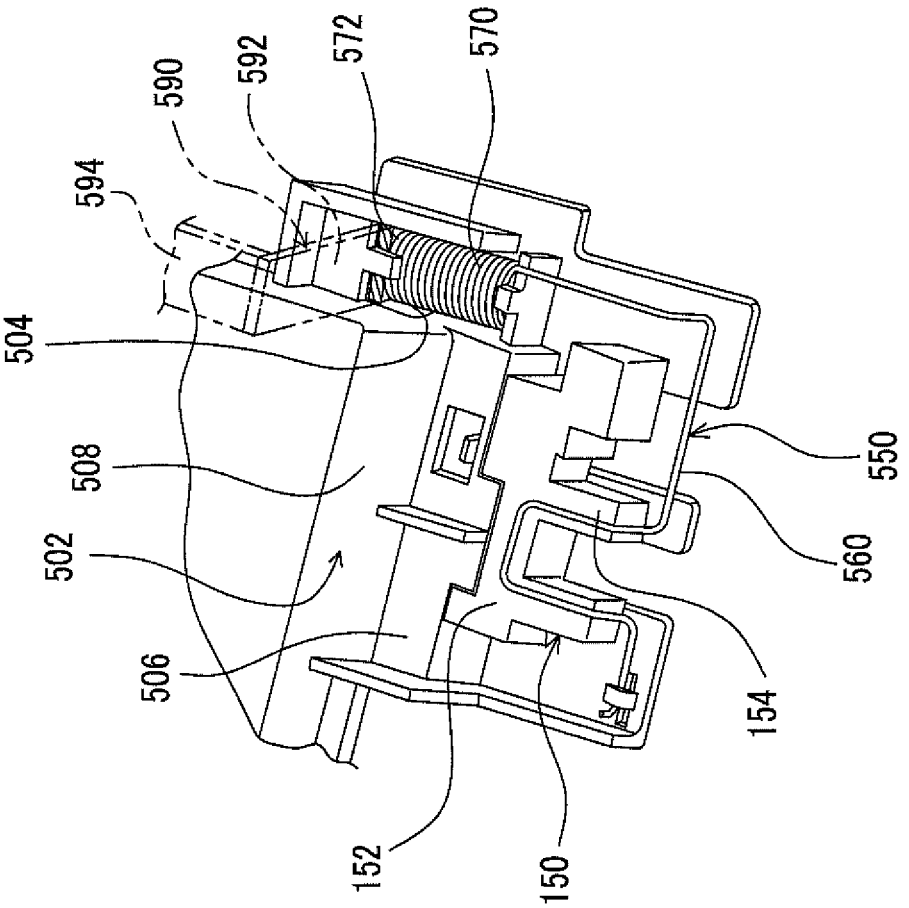
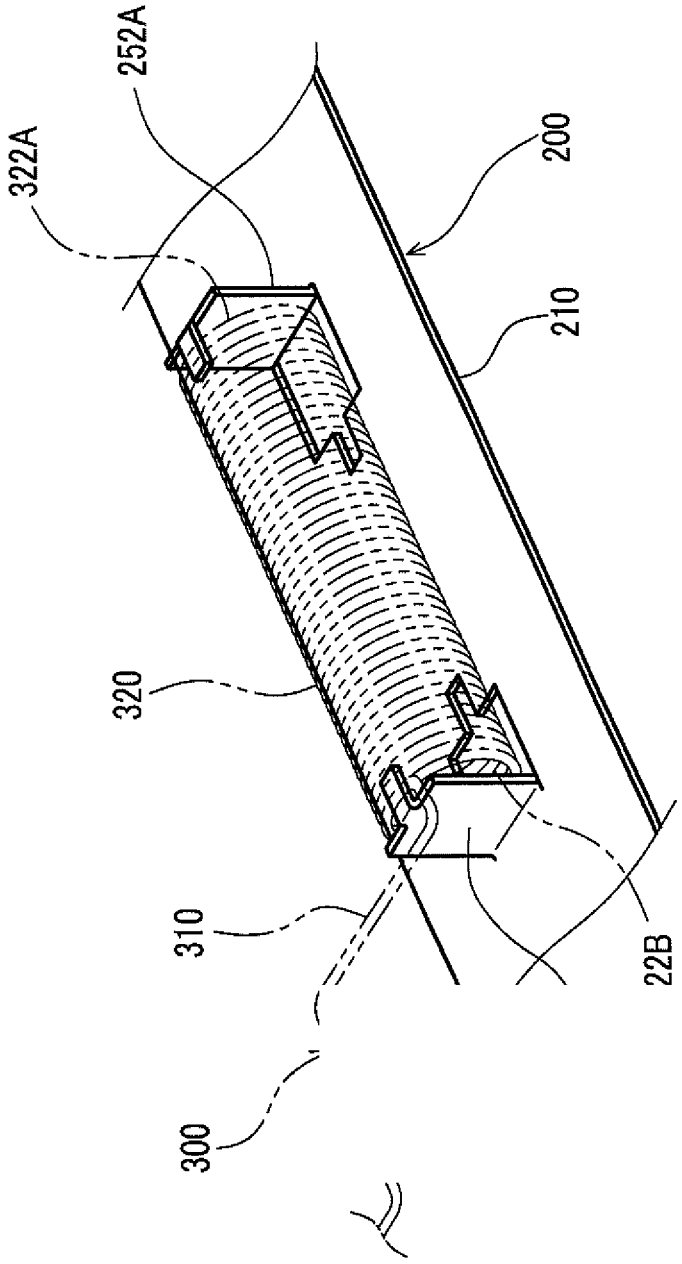


FIG. 7



GROUNDING STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2013-146197 filed Jul. 12, 2013.

BACKGROUND

Technical Field

The present invention relates to a grounding structure.

SUMMARY

According to an aspect of the invention, there is provided a grounding structure including:

a grounding member that is grounded;

an electrical conduction member that includes a protection section which is placed to protect a protection object, and an elastic portion which is connected to the protection section and is elastically deformed, the electrical conduction member being conductible; and

a holding section that is formed in the grounding member and that holds the elastic portion in the grounding member by using an elastic force of the elastic portion,

wherein the holding section and the elastic portion contact with each other on both sides of a direction in which the elastic force of the elastic portion acts.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention will be described in detail based on the following figures, wherein:

FIG. **1** is a configuration diagram showing a configuration of an image forming apparatus according to an exemplary embodiment of the present invention;

FIG. **2** is a perspective diagram showing placement positions of a sensor and a charge-removal member of the image forming apparatus according to the exemplary embodiment of the present invention;

FIG. **3** is an enlarged perspective diagram in which main parts of FIG. **2** are enlarged;

FIG. **4**A is an enlarged perspective diagram of FIG. **2** showing a state where the charge-removal member is not mounted, FIG. **4**B is an enlarged perspective diagram showing a state where the charge-removal member is mounted, and FIG. **4**C is a perspective diagram showing the charge-removal member;

FIGS. **5**A and **5**B are schematic diagrams of a detection mechanism, FIG. **5**A is a plan view seen from a Z direction, and FIG. **5**B is a side view seen from a Y direction;

FIG. **6** is a perspective diagram showing main parts of a detection mechanism according to a comparative example; and

FIG. **7** is a perspective diagram showing main parts of a detection mechanism according to a modification example.

DETAILED DESCRIPTION

An example of an image forming apparatus according to an exemplary embodiment of the present invention will be described.

Overall Configuration

Configuration of Image Forming Apparatus

First, the configuration of an image forming apparatus **10** will be described. FIG. **1** is a configuration diagram showing the configuration of the image forming apparatus **10**. A vertical direction upper side is a Z direction, an apparatus front side is an X direction, and a direction in which the Z direction and the X direction intersect with each other (apparatus width direction outer side) is a Y direction.

As shown in FIG. **1**, the image forming apparatus **10** includes an apparatus body **11** in which each of components is accommodated. Plural accommodating sections **12** that accommodate a recording medium P such as a sheet, an image forming section **14** that forms an image on the recording medium P, a fixing device **56** that fixes the image that is formed on the recording medium P by the image forming section **14** onto the recording medium P, a transport unit **16** that transports the recording medium P from the accommodating section **12** to the image forming section **14**, and a control unit **20** that controls an operation of each part of the image forming apparatus **10** are disposed in the apparatus body **11**. Also, a discharge unit **18** that discharges the recording medium P on which the image is fixed by the fixing device **56** is disposed in an upper portion of the apparatus body **11**.

The image forming section **14** has a photoconductor drum **32** that is an example of an image holding member which holds the image. The photoconductor drum **32** rotates in one direction (for example, counterclockwise direction in FIG. **1**). A charging roller **23** that is an example of a charging device which charges the photoconductor drum **32**, an exposure device **36** that forms an electrostatic latent image in the photoconductor drum **32** by exposing the photoconductor drum **32** which is charged by the charging roller **23**, a developing device **80** that forms a black toner image by developing the electrostatic latent image which is formed in the photoconductor drum **32** by the exposure device **36**, and a transfer roller **26** that transfers the black toner image which is formed in the photoconductor drum **32** by the developing device **80** to the recording medium P are disposed around the photoconductor drum **32** in order from a rotation direction upstream side of the photoconductor drum **32**.

The exposure device **36** exposes exposure light L to the photoconductor drum **32** based on an image signal that is sent from the control unit **20**, and forms the electrostatic latent image in the photoconductor drum **32**. Examples of the image signal that is sent from the control unit **20** include an image signal acquired by the control unit **20** from an external device.

A toner cartridge **58** is disposed above the exposure device **36** as a toner accommodating container that accommodates toner. A toner accommodation chamber **58**A in which the toner is accommodated is formed within the toner cartridge **58**.

A toner transport device **60** that transports the toner from the toner accommodation chamber **58**A of the toner cartridge **58** toward the developing device **80** is disposed between the toner cartridge **58** and the developing device **80**.

The transfer roller **26** opposes the photoconductor drum **32**, and transports the recording medium P upward with the photoconductor drum **32** by nipping the recording medium P. A position between the transfer roller **26** and the photoconductor drum **32** is defined as a transfer position T where the toner image formed in the photoconductor drum **32** is transferred onto the recording medium P.

The transport unit **16** has a feed roller **46** that feeds the recording medium P which is accommodated in each of the accommodating sections **12**, a transport path **48** through which the recording medium P fed by the feed roller **46** is

transported, and plural feed rolls **50** that are placed along the transport path **48** and transports the recording medium P fed by the feed roller **46** to the transfer position T.

The fixing device **56** has a heating roll **56**A and a pressure roll **56**B. The fixing device **56** fixes the toner image that is transferred to the recording medium P by the transfer roller **26** onto the recording medium P through heating by the heating roll **56**A and pressurization by the pressure roll **56**B. A discharge roller **52** that discharges the recording medium P on which the toner image is fixed toward the discharge unit **18** is disposed on a side above the fixing device **56** (transport direction downstream side).

Also, as will be described later, a detection mechanism **100** that detects the recording medium P which is discharged to the discharge unit **18** by the discharge roller **52** is disposed in the vicinity of the discharge roller **52** (refer to FIG. **2**).

Also, a reversing transport path **37** that reverses the recording medium P on which the toner image is fixed on one side and sends the recording medium P back to the transfer position T is disposed on the opposite side (right side in FIG. **1**) to the photoconductor drum **32** with respect to the transfer roller **26**. When the image is formed on both sides of the recording medium P, the recording medium P on which the toner image is fixed on the one side is switched back by the discharge roller **52**, is guided to the reversing transport path **37**, and is sent back to the transfer position T.

Image Forming Operation

Next, an image forming operation of the image forming apparatus **10** in which the image is formed on the recording medium P will be described.

In the image forming apparatus **10**, the recording medium P that is fed by the feed roller **46** from any one of the accommodating sections **12** is fed toward the transfer position T by the plural feed rolls **50**.

In the image forming section **14**, the photoconductor drum **32** is charged by the charging roller **23** and then is exposed by the exposure device **36**, and the electrostatic latent image is formed in the photoconductor drum **32**. The electrostatic latent image is developed by the developing device **80**, and the black toner image is formed in the photoconductor drum **32**. The black toner image is transferred onto the recording medium P by the transfer roller **26** at the transfer position T.

The recording medium P on which the toner image is transferred is transported toward the fixing device **56**, and the toner image is fixed by the fixing device **56**. In a case where the image is formed on only the one side of the recording medium P, the recording medium P is discharged toward the discharge unit **18** by the discharge roller **52** after the toner image is fixed.

In a case where the image is formed on both of the sides of the recording medium P, the recording medium P is switched back with the discharge roller **52**, is reversed, and is fed toward the reversing transport path **37** after the image is formed on the one side. Further, the recording medium is fed back toward the transfer position T from the reversing transport path **37**, the image is formed in a similar manner as described above on the opposite side where the image is not recorded, and the recording medium P is discharged toward the discharge unit **18** by the discharge roller **52**.

The discharge of the recording medium P toward the discharge unit **18** is detected by the detection mechanism **100** that will be described later.

Detection Mechanism

As shown in FIGS. **1**, **5**A, and **5**B, the detection mechanism **100** is provided with a detection member **110** that has a rotating shaft **112** which is rotatably disposed in the Y direction, a claw portion **114** that is disposed in an axial direction central part of the rotating shaft **112**, and a detection piece section **116** that is disposed in an end portion of the rotating shaft **112**. As shown in FIG. **1**, the detection member **110** is placed in the vicinity of a transport direction upstream side from the discharge roller **52**.

As shown in FIG. **5**B, a sensor **150** as a detector is disposed in the vicinity of an axial direction outside end portion of the detection member **110**.

As shown in FIG. **2**, the sensor **150** is mounted on a resinous housing **102** at a Y direction outside part of the fixing device (refer also to FIG. **3**).

As shown in FIGS. **3**, **5**A, and **5**B, the sensor **150** is a transmission type photo sensor that has a body section **152** and a pair of detection units **154** which are disposed in the body section **152** with a gap from each other, a light-emitting element being disposed in one of the pair of detection units **154** and a light receiving element being disposed in the other. The sensor **150** is configured in such a manner that detection light is emitted from the light-emitting element of the one of the detection units **154** and the detection light is received by the light receiving element of the other of the detection units **154**. The sensor **150** electrically converts the detection light that is received by the light receiving element, and feeds a signal to a control device which is not shown herein.

Normally (during non-discharge), the detection piece section **116** of the detection member **110** is placed between the pair of detection units **154** of the sensor **150** as shown in FIGS. **5**A and **5**B. As such, normally (during non-discharge), the detection piece section **116** is in a state of shielding the detection light.

As shown with an imaginary line (dashed line) in FIG. **5**B, the recording medium (recording sheet) P hits the claw portion **114** of the detection member **110** and the rotating shaft **112** rotates when the discharge of the recording medium P is initiated. When the rotating shaft **112** rotates, the detection piece section **116** falls out from between the pair of detection units **154** and the detection light is received by the light receiving element so that it is detected that the recording medium P is being discharged. When the discharge of the recording medium P is completed, the detection piece section **116** returns to an original state so that the detection light is shielded and it is detected that the discharge of the recording medium P is completed.

In addition, normally (during non-discharge), the detection piece section **116** may be configured to fall out from between the pair of detection units **154** in a state where the detection light is received by the light receiving element (imaginary line (dashed line)) and, during the discharge of the recording medium P, the detection piece section **116** may be configured to be in a state of shielding the detection light (solid line).

As shown in FIGS. **3**, **4**A, **4**B, and **4**C, the detection mechanism **100** has a sheet metal **200** (FIG. **4**A) as an example of a grounding member, and a charge-removal member (lightning rod) **300** (FIG. **4**C) as an example of an electrically conductive member.

As shown in FIGS. **3** and **4**A, the sheet metal (first metal member) **200** is band-shaped and is fixed to the resinous housing **102**. Also, the sheet metal **200** is bent in an L shape when viewed from a side, and is electrically connected to a metallic apparatus housing, not shown herein, in which an upper surface portion **212** is electrically grounded. Accordingly, the sheet metal **200** is also grounded.

A mounting hole **220** is formed in a mounting surface (vertical surface) **210** of the sheet metal **200**. The mounting hole **220** has a substantially rectangular shape, and convex

portions **222**A and **222**B are formed in inner edge portions **220**A and **220**B opposing each other in a longitudinal direction.

As shown in FIG. **4**C, the charge-removal member (second metal member) **300** is configured to have a linear-shaped wire section (linear-shaped section) **310**, and a coil-shaped spring section **320** that is formed in an end portion of the wire section **310**. The charge-removal member **300** is formed from a wire of SUS and is electrically conductive. As shown in FIGS. **3** and **4**B, the linear-shaped wire section **310** of the charge-removal member **300** is placed in close proximity along the vicinity of the sensor **150** that is a protection object, and is placed to protect the sensor **150**. Specifically, the wire section **310** is around the pair of detection units **154** of the sensor **150** and the body section **152** therealong, and an end portion **312** is inserted into and fixed to a hole of a projecting portion **104** that is formed at a position of the resinous housing **102** which is separated from the sensor **150**. The protection of the sensor **150** will be described later.

As shown in FIGS. **3** and **4**B, the spring section **320** of the charge-removal member **300** is formed as a compression coil spring, and the spring section **320** is fitted (held) in a compressively deformed state to the mounting hole **220** of the mounting surface **210** of the sheet metal **200**. In this manner, the spring section **320** of the charge-removal member **300** and the sheet metal **200** are electrically conductive to each other.

In this exemplary embodiment, specifications of the spring section **320** such as a spring constant and a spring length, a gap between the inner edge portions **220**A and **220**B of the mounting hole **220** and the like are set in such a manner that a pressing force with which an end portion **322**A of the spring section **320** of the charge-removal member **300** is pressed against the inner edge portion **220**A of the mounting hole **220** is at least 2N.

The convex portions **222**A and **222**B of the inner edge portions **220**A and **220**B of the mounting hole **220** are put into the spring section **320** as stoppers. Also, the end portion **312** of the wire section **310** of the charge-removal member **300** is in an electrically floating state.

Effect

Next, an effect of this exemplary embodiment will be described.

Effect of the Charge-Removal Member

First, the effect of the charge-removal member (lightning rod) **300** will be described.

The charge-removal member **300** is electrically conductive to the sheet metal **200**, and the sheet metal **200** is grounded. Accordingly, in a case where static electricity is generated for some reason in the vicinity of the sensor **150**, the static electricity is discharged (applied) to the wire section **310** of the charge-removal member **300**, and flows to the sheet metal **200** where the end portions **322**A and **322**B of the spring section **320** are pressed to be conductive. Accordingly, a misoperation of the sensor **150** due to the discharge (application) of the static electricity to the sensor **150** is prevented.

COMPARATIVE EXAMPLE

Next, the comparative example will be described.

A charge-removal member **550** of the comparative example that is shown in FIG. **6** is configured to have a linear-shaped wire section **560** and a spring section **570** which are placed in close proximity in the vicinity of the sensor **150**. The spring section **570** is fitted to and held by a recessed portion **504** that is formed in a resinous housing **502**. Also, a mounting surface (vertical surface) **592** of a grounded and band-shaped sheet metal **590** is fixed to an end face of the recessed portion **504**.

An end portion **572** of the spring section **570** of the charge-removal member **550** is pressed against the mounting surface **592** of the sheet metal **590** so that the spring section **570** of the charge-removal member **550** and the sheet metal **590** are electrically conductive to each other. Also, an upper surface portion **594** of the sheet metal **590** is electrically connected to the electrically grounded metallic apparatus housing, which is not shown herein.

Effect

Next, the effect of this exemplary embodiment will be described in comparison to the comparative example.

In the comparative example that is shown in FIG. **6**, a space (recessed portion **504**) to hold the spring section **570** of the charge-removal member **550** is required to be ensured in the resinous housing **502** (Y direction outside part of the fixing device in the image forming apparatus). Also, for this reason, an extra space **506** is generated between a wall surface **508** of the resinous housing **502** and the sensor **150**.

In contrast, in this exemplary embodiment, the spring section **320** of the charge-removal member **300** is fitted to and held by the mounting hole **220** formed in the grounded sheet metal **200** in a compressively deformed state as shown in FIGS. **3**, **4**A, **4**B, and **4**C. Accordingly, there is no need to ensure an additional space (recessed portion **504**, refer to FIG. **6**) to hold the spring section **320** in the resinous housing **102**. Also, for this reason, a wall surface **108** and the sensor **150** are placed in close proximity and the extra space **506** (refer to FIG. **6**) as in the comparative example is not generated. Accordingly, (a part in the vicinity of the sensor **150** of) the Y direction outside part of the fixing device **56** of the image forming apparatus **10** according to this exemplary embodiment shown in FIGS. **3**, **4**A, **4**B, and **4**C is reduced in space compared to the comparative example of FIG. **6**.

Also, a holding section (recessed portion **504**, refer to FIG. **6**) to hold the spring section **320** does not have to be formed in the resinous housing **102**, and thus costs are saved and the degree of design flexibility is improved for the resinous housing **102**.

Also, in the comparative example that is shown in FIG. **6**, a manufacturing tolerance (irregularity) of the recessed portion **504** of the resinous housing **502** causes an increased positional irregularity between the spring section **570** and the mounting surface **592** of the sheet metal **590** and an increased irregularity, that is, contact pressure, of the pressing force with which the end portion **572** of the spring section **570** of the charge-removal member **550** is pressed against the mounting surface **592** of the sheet metal **590**.

Accordingly, in a case where a high contact pressure is not ensured (in a case where the pressing force of at least 2N is not ensured) due to the manufacturing tolerance (irregularity), there is a concern that conduction resistance between the spring section **570** of the charge-removal member **550** and the sheet metal **590** increases and the static electricity is discharged (applied) to the sensor **150** without being discharged (applied) to the wire section **560** of the charge-removal member **550**.

In contrast, in this exemplary embodiment, the spring section **320** of the charge-removal member **300** is fitted to and held by the mounting hole **220** of the mounting surface **210** of the sheet metal **200** in a compressively deformed state as shown in FIGS. **3**, **4**A, **4**B, and **4**C, and thus is not affected by the manufacturing tolerance (irregularity) of the resinous housing **102**. Further, both of the end portions of the spring section **320** contact with the sheet metal **200**. Herein, both of

the end portions are both of the end portions in a direction in which an elastic force of the spring section **320** acts, that is, a direction in which the spring section **320** is deformed.

Accordingly, an irregularity of the contact pressure with which the end portions **322**A and **322**B of the spring section **320** of the charge-removal member **300** are pressed against the inner edge portions **220**A and **220**B of the mounting hole **220** is suppressed, and thus an irregularity of the conduction resistance between the spring section **320** of the charge-removal member **300** and the sheet metal **200** is suppressed.

Further, in this exemplary embodiment, the specifications of the spring section **320** such as the spring constant, the gap between the inner edge portions **220**A and **220**B of the mounting hole **220** and the like are set in such a manner that the pressing force with which the end portion **322**A of the spring section **320** of the charge-removal member **300** is pressed against the inner edge portion **220**A of the mounting hole **220** is at least 2N so that a state where the conduction resistance is low is ensured.

Accordingly, the static electricity is prevented from being discharged (applied) to the sensor **150** without being discharged (applied) to the wire section **310** of the charge-removal member **300** by an increased conduction resistance between the spring section **320** of the charge-removal member **300** and the sheet metal **200**.

MODIFICATION EXAMPLE

Next, the modification example of this exemplary embodiment will be described.

In this exemplary embodiment, the spring section **320** of the charge-removal member **300** is mounted on the mounting hole **220** that is formed on the mounting surface **210** of the sheet metal **200**, but the present invention is not limited thereto.

For example, as shown in FIG. **7**, the spring section **320** of the charge-removal member **300** maybe held in a compressively deformed state between a cut-and-raised piece **252**A and a cut-and-raised piece **252**B that are formed by being cut and raised on the mounting surface **210** of the sheet metal **200** and oppose each other.

Others

The present invention is not limited to the above-described exemplary embodiment.

Various configurations are possible as the configuration of the image forming apparatus without being limited to the configuration of the above-described exemplary embodiment. Also, in the above-described exemplary embodiment, the image is formed by an electrophotographic system, but the present invention is not limited thereto. The present invention may be applied to image forming apparatuses that form an image by other known methods such as an inkjet method and a thermal transfer method.

Also, in the above-described exemplary embodiment, the present invention is applied to the (sensor of) detection mechanism that detects the discharge of the recording medium, but the present invention is not limited thereto. The present invention may be widely applied to a structure in which the charge-removal member is disposed so as to prevent the discharge (application) of the static electricity toward the sensor. Also, the protection object is not limited to the sensor, but may be used with respect to a terminal such as a memory.

Further, it is a matter of course that the present invention can be embodied by various aspects without departing from the scope of the present invention.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A grounding structure comprising:

a grounding member that is grounded;

an electrical conduction member that includes a protection section which is placed to protect a protection object, and an elastic portion which is connected to the protection section and is elastically deformed, the electrical conduction member being conductible; and

a holding section that is formed in the grounding member and that holds the elastic portion in the grounding member by using an elastic force of the elastic portion,

wherein the holding section and the elastic portion contact with each other on both sides of a direction in which the elastic force of the elastic portion acts.

2. The grounding structure according to claim **1**,

wherein the holding section is a hole section that is formed in the grounding member, and the elastic portion is fitted into the hole section.

3. The grounding structure according to claim **1**,

wherein the holding section includes convex portions formed in inner edge portions opposing each other in the ground member.

4. The grounding structure according to claim **1**,

wherein the holding section includes cut-and-raised pieces formed in inner edge portions opposing each other in the ground member.

5. The grounding structure according to claim **1**,

wherein a pressing force pressed against the holding section is at least 2N.

* * * * *